

# U.S. Army Center for Health Promotion and Preventive Medicine

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## A SURVEY OF PARACHUTE ANKLE BRACE BREAKAGES

USACHPPM REPORT NO. 12-MA01Q2A-08

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<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b> <p>The parachute ankle brace (PAB) has been shown to reduce the incidence of ankle injuries, while not complicating parachute entanglements or increasing injuries in other parts of the body. On the other hand, PABs have a limited lifespan so a survey was conducted to identify areas of the PAB most susceptible to breakage. A total of 1,668 individual ankle braces judged non functional by the United States Army Airborne School were analyzed. Plastic shells, ankle straps, and heel straps accounted for 14%, 27% and 59% of the breakages, respectively. The areas with the greatest number of breakages were (in order of frequency): 1) the Velcro portion of the heel strap, 2) the center of the heel strap, 3) the rivet/screw at the Velcro end of the heel strap, and 4) the back of the plastic shell. These four types of breakages collectively accounted for 64% of all the breakages. Of the multiple breakage events, 89% involved the heel strap. These data indicate that the majority of breakages occurred to the heel strap. The reason for heel strap breakages is most likely the change in the military boot. The PAB was originally designed for the older black combat boot. When the PAB was placed on the newest desert boot, the heel strap could slip over the curved part of the heel causing the PAB to move backwards; the heel strap could be stepped upon and abraded. Improvements have been proposed by the brace manufacturer in consultation with the USAAS to add a stabilizing strap over the dorsum of the foot. There was also a suggestion in the data that recent improvements in the composition of the plastic shell have improved breakage resistance.</p>					
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**EXECUTIVE SUMMARY  
USACHPPM REPORT NUMBER 12-MA01Q2A-08  
A SURVEY OF PARACHUTE ANKLE BRACE BREAKAGES**

**1. INTRODUCTION.** Previous investigations have demonstrated that the parachute ankle brace (PAB) reduces the incidence of ankle injuries without complicating parachute entanglements or increasing injuries in other parts of the lower body. On the other hand, the PABs have a limited lifespan so it is useful to identify areas of the brace most susceptible to breakage. This paper reports and analyzes PAB breakages.

**2. METHODS.**

a. PABs were phased into the United States Army Airborne School (USAAS) from April 2005 to December 2006. The Quality Assurance Office at Ft Benning returned any PABs that were no longer functional to the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM). Lack of functionality was determined by the USAAS cadre as a brace that was assumed to no longer protect against ankle injury.

b. Four batches of braces were returned to the USACHPPM between June 2005 and September 2007. Returned braces were inventoried by the USACHPPM and a categorization scheme was developed based on the breakages observed. Breakages could have involved three major areas: 1) the plastic shell, 2) the ankle strap, or 3) the heel strap. The plastic shell could be broken at the side or back. There were two ankle straps (top and bottom) and breakages could involve 1) a strap torn near the rivet, 2) a strap torn at Velcro hooks, 3) a strap torn in middle, and/or 4) a broken buckle. Breakages at the heel strap could involve 1) a tear near the middle, 2) a tear in Velcro portion of the strap, 3) a broken heel strap rivet or screw on the buckle end, 4) a broken heel strap rivet or screw on the Velcro end, and/or 4) a buckle severely bent and not serviceable.

**3. RESULTS.**

a. A total of 1668 individual ankle braces (single braces not pairs) with breakages were returned to the USACHPPM. There were 1,356 PABs with one breakage location, 271 with two breakage locations, 37 with three breakage locations, and 4 with four breakage locations. Thus, there were a total of 2,025 individual breakage events.

b. Plastic shells, ankle straps, and heel straps accounted for 14%, 27% and 59% of the breakages, respectively. The areas with the greatest number of breakages were (in order of frequency): 1) the Velcro portion of the heel strap, 2) the center of the heel

strap, 3) the rivet/screw at the Velcro end of the heel strap, and 4) the back of the plastic shell. These four types of breakages collectively accounted for 64% of all the breakages.

c. There were 312 braces with multiple breakages. The most common multiple breakages were: 1) torn Velcro on both ankle straps (n=35), 2) a torn heel strap rivet/screw on the Velcro side combined with a torn heel strap Velcro (n=29) and, 3) broken shell back combined with a torn heel strap Velcro (n=24). Of the multiple breakages, 89% involved the heel strap.

#### **4. DISCUSSION.**

a. The data indicates that the majority of breakages occurred to the heel strap of the PAB. The Velcro attachment was the single area with the largest number of breakages but the center of the strap and the rivet on the Velcro end were subject to the second and third greatest number of breakages. In the multiple breakage events, the heel strap was involved in almost 90% of the cases. The reason for heel strap breakages is most likely the change in the military boot. The PAB was originally designed for the older black combat boot. This boot had a heel and the heel strap fit under the instep of the boot in front of the heel. This location secured the PAB, preventing backward slippage and the heel strap was located where it would experience minimal contact with the ground. The first “new” boot was the desert boot with a heel so the heel strap still functioned as designed. However, about July 2005 a new desert boot was issued in Army Basic Combat Training and this new boot had a minimal heel area. Soldiers arriving at the USAAS from BCT had this new boot. When the PAB was placed on this new boot the heel strap could slip over the now curved part of the heel causing the PAB to move backwards and placing the heel strap under the heel where it could be stepped upon. The heel strap life span would be reduced since it was subject to abrasion from the concrete in the harness shed, asphalt on the loading ramp, and dirt on the drop zone.

b. DJ Ortho<sup>®</sup> (the brace manufacturer) in consultation with the USAAS developed a design that moved the stabilizing strap from the bottom of the boot to a location across the top of the foot. A buckle attaching to the ankle strap is located on both sides of the brace. A Velcro strap is inserted into the buckle and secured across the top (dorsum) of the foot to better hold the brace in place. This should prevent the PAB from slipping off the boot and improve the durability of the strap.

c. There have been 3 generations of the PAB. Braces returned to the USACHPPM in batches 1 through 3 were of the second generation but the last batch of braces had both second and third generation braces. DJ Ortho had made improvements to the plastic composition of the PAB for the third generation brace. Unfortunately, no distinction was made between the second and third generation braces in the fourth batch inventory and broken braces were disposed of because of storage problems before this was considered. It was calculated that shell breakages accounted for 19% (199/1048) of the combined batch 1 through 3 breakages while shell breakages accounted for 11% (71/621) of all batch 4 breakages. The smaller proportion of shell breakages in the last batch suggests the third generation PAB shell may be more resistant to breakage.

**5. CONCLUSIONS.** The major breakage location on the PAB was the heel strap. On the heel strap, the Velcro, the center of the strap, and the rivet on the Velcro end were the specific areas subject to the greatest number of breakage events. A proposed modification has been developed by DJ Ortho<sup>®</sup> in consultation with the USAAS to more effectively hold the brace on the boot and reduce heel strap breakages. This modification adds a strap over the dorsum of the foot. The ankle strap at the Velcro attachment was also found to have a high level of breakage and strengthening the attachment of the Velcro hooks to the strap may decrease the breakage incidence in this area. The modification of the plastic shell in the third generation PAB may have resulted in less shell breakage.

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**USACHPPM REPORT NUMBER 12-MA01Q2A-08**  
**A SURVEY OF PARACHUTE ANKLE BRACE BREAKAGES**

**1. REFERENCES.** Appendix A contains the scientific/technical references used in this report.

**2. PURPOSE.** This report summarizes and analyzes information regarding parachute ankle brace (PAB) breakage points and cites improvements that have been made.

**3. AUTHORITY.** Under Army Regulation 40-5 (3), the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) is responsible for providing epidemiological consultation services upon request. This project was part of an investigation examining the effectiveness of the PABs initiated by the Military Training Task Force (MTTF) of the Defense Safety Oversight Council (DSOC). The USACHPPM agreed to the project in coordination with the United States Army Research Institute of Environmental Medicine (USARIEM). USARIEM had responsibility for both the on-site data collection and database analysis. However, when the principal USARIEM investigator departed, USACHPPM assumed responsibility for the on-site data collection and analysis, which is the topic of this report. Documents related to the project appear in Appendix B.

**4. BACKGROUND.**

a. Since World War II, military airborne operations have delivered troops to key areas of the battlefield, altering the tactical and strategic aspects of warfare. The idea of tactical military airborne operations was first proposed in 1919 by William (Billy) Mitchell and approved by General John J Pershing. However, with the quick end of World War I the idea was never realized. In 1928 the United States (US) Army Air Corps staged a number of airborne demonstration jumps in Texas that were observed by foreign army representatives, but the Soviet Union was the first country to develop military airborne units in the 1930s. This was quickly followed by developments in Germany culminating in the first combat jumps, which spearheaded the German invasion into the Netherlands in May 1940. The US Army formed a platoon of airborne troops in July 1940 and initiated the first jump school at Fort Benning, Georgia, in April 1941 (8, 10).

b. While military parachuting techniques were being developed, studies indicated that injury incidences were 210 to 240/10,000 descents (7, 18). As parachute design and jump procedures improved, injury rates declined to about 60 injuries/10,000 descents (5).



The ankle was shown to be the most common anatomical site of injury, accounting for 21% to 43% of all injuries (1, 2, 6, 9, 11). Stemming these high rates of ankle injuries and from promising studies showing a reduction in ankle injuries in sports activities (13, 16, 17), the US Army worked with Aircast<sup>®</sup> Corporation (subsequently purchased by DjOrtho<sup>®</sup> in 2006) to develop an outside-the-boot ankle brace for military airborne operations. This device, known as the PAB, was tested at the US Army Airborne School (USAAS) in 1993 and was shown to effectively reduce the incidence of inversion ankle sprains (2). In 1994, the US Army adopted use of the brace for all airborne operations (4). A subsequent evaluation among US Army Airborne Rangers showed a 57% reduction in ankle injuries when the brace was employed (15). Despite these positive outcomes, PAB use was discontinued in 2000 because of the costs of maintaining the brace and anecdotal reports that the brace increased injuries in other parts of the lower body and complicated parachute entanglements. A study of students at the USAAS compared the period of PAB use (1994–2000) to the period after the PAB was discontinued (2000–2002) and showed that the risk of an ankle injury hospitalization was 1.7 times higher after the PAB was no longer used (14).

c. In 2004, USACHPPM worked with USARIEM and the DSOC to reinstitute use of the PAB in military airborne operations. The DSOC required information to demonstrate that the PAB was still effective in light of changes in military equipment and uniforms. PABs were purchased for the USAAS and they were evaluated over a 21-month period (April 2005–December 2006). This evaluation demonstrated that after controlling for wind speed, combat loading, and night jumps (covariates known to increase airborne injuries), airborne students who did not wear the brace were 1.90 times more likely to experience an ankle sprain, 1.47 times more likely to experience an ankle fracture, and 1.75 times more likely to experience an ankle injury of any type. Injuries to other parts of the lower body (exclusive of the ankle) were not significantly influenced by the brace and the incidence of parachute entanglements were similar among students wearing and not wearing the PAB (12).

d. As part of this latter project braces that were no longer functional were returned to the USACHPPM for evaluation. The USACHPPM examined these braces and categorized breakage locations. The purpose of this paper is to report and analyze PAB breakages.

## 5. METHODS.

**a. Airborne School.** The USAAS at Ft Benning Georgia has the responsibility for training all Soldiers, Marines, Sailors, and Airmen in the practical aspects of military parachuting. Students must successfully complete a three-week training course. The first two weeks involve training on aircraft exit and ground landing techniques. The third week involves actual parachute descents. To graduate from Airborne School students must complete five parachute jumps from C-17 or C-130 aircraft from altitudes of 1,000 to 1,250 feet. The first jump is an individual effort with one second between jumpers and 10 jumpers exiting from each side of the aircraft. The other jumps are mass exits with 15 jumpers exiting in quick succession from each side of the aircraft.

Use of trademarked names does not imply endorsement by the US Army, but is intended only to assist in identification of a specific project.
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**b. PAB Phase-In.** Batches of PABs were purchased for the USAAS from April 2005 to December 2006. Students who wore the PAB during parachute descents were instructed on proper fitting and wear and familiarized with the PAB during the first two weeks of training. They jumped with the brace on the third week of training.

**c. PAB Generations.** There have been three generations of the PAB produced by Aircast® Corporation and DJ Ortho®. The first, second, and third generation are shown in Figures 1, 2, and 3, respectively. The braces are similar with some small changes. The first generation brace had air sacks that padded the ankle and lower leg area. In the second generation PAB, these air sacks were replaced with closed cell foam. In the third generation PAB, the plastic composition was changed and a screw replace the rivet on the buckle side of the heel strap so the heel strap could be more easily replaced. During the PAB study of injuries from April 2005 to December 2006 (12), the second generation brace was used. After completion of the injury study, third generation braces were purchased for the USAAS and these were gradually phased into training.

**Figure 1. First-Generation Parachute Ankle Brace**



**Figure 2. Second-Generation Parachute Ankle Brace**





**Figure 3. Third-Generation Parachute Ankle Brace**



**d. PAB Breakages**

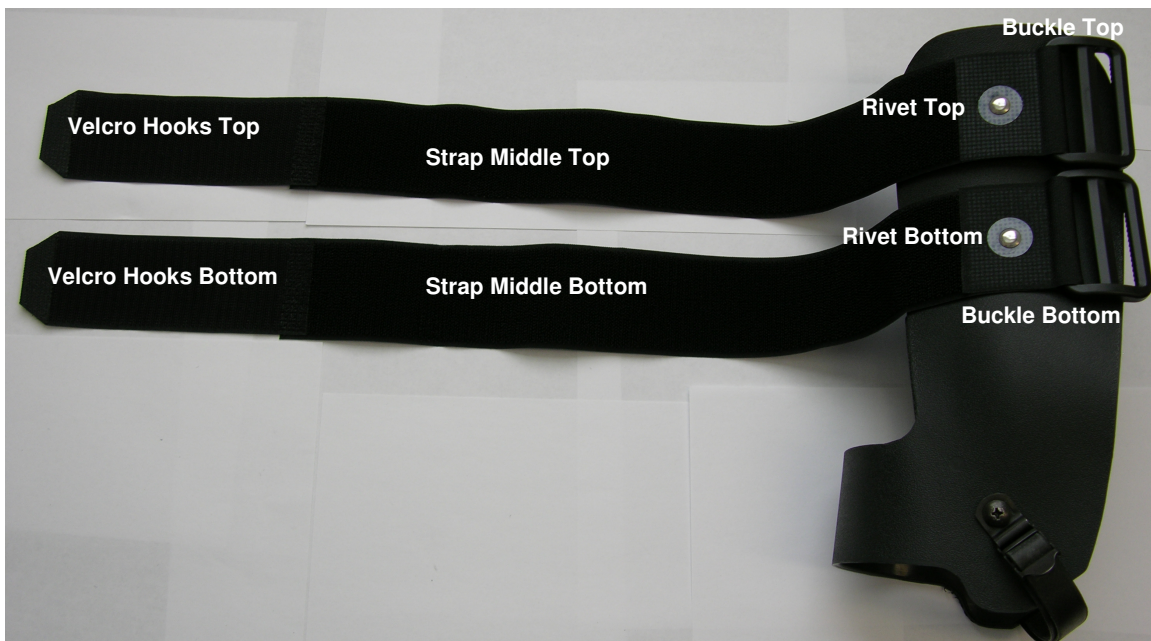
(1) While the braces were being phased into the USAAS, the Quality Assurance Office at Ft Benning was asked to return to the USACHPPM any PABs that were no longer functional. Lack of functionality was determined by the USAAS cadre as a brace that was assumed to no longer protect against ankle injuries.

(2) Four batches of braces were returned to the USACHPPM between June 2005 and September 2007. Returned braces were inventoried by the USACHPPM and a categorization scheme was developed based on the breakages observed. Breakages could have involved three major areas: 1) the plastic shell, 2) the ankle strap, or 3) the heel strap. The plastic shell could be broken at the side or back (Figure 4). There were two ankle straps (top and bottom) and breakages could involve 1) a strap torn near the rivet, 2) a strap torn at Velcro hooks, 3) a strap torn in middle, and/or 4) a broken buckle (Figure 5). Breakages at the heel strap could involve 1) a tear near the middle, 2) a tear in Velcro portion of the strap, 3) a broken heel strap rivet or screw on the buckle end, 4) a broken heel strap rivet or screw on the Velcro end, and/or 4) a buckle severely bent and not serviceable (Figure 6).

**Figure 4. Parachute Ankle Brace Plastic Shell Components**



**Figure 5. Parachute Ankle Brace Ankle Strap Components**





**Figure 6. Parachute Ankle Brace Heel Strap Components**



## 6. RESULTS.

a. A total of 1668 individual ankle braces (single braces not pairs) with breakages were returned to the USACHPPM between June 2006 and September 2007. Batches 1 through 4 contained 152, 121, 775, and 620 braces, respectively. Batches 1 through 3 contained only second generation braces; batch 4 contained both second and third generation braces.

b. An examined brace could have had more than one breakage location. There were 1,356 PABs with one breakage location, 271 with two breakage locations, 37 with three breakage locations, and 4 with 4 breakage locations. Thus, there were a total of 2,025 individual breakage events.

c. Table 1 contains a summary of the individual breakages events. Plastic shells, ankle straps, and heel straps accounted for 14%, 27% and 59% of the breakages, respectively. Ankle straps torn near the rivet, near the middle, and near the Velcro hooks accounted for 4%, 2% and 12% of all breakages, respectively. The areas with the greatest number of breakages were (in order of frequency): 1) the Velcro portion of the heel strap, 2) the center of the heel strap, 3) the rivet/screw at the Velcro end of the heel strap, and 4) the back of the plastic shell. These four types of breakages collectively accounted for 64% (1306/2025) of all the breakages (Table 1).

**Table 1. PAB Breakages by Individual Event<sup>a</sup>**

Brace Area	General Breakage Location	Specific Breakage Location	Events (n)	Proportion of Total Breakages (%)
Plastic Shell (n=270)		Back	225	11.6
		Side	43	2.2
		Both Sides	1	0.1
		Side and Back	1	0.1
Ankle Strap (n=532)	Strap Torn Near Rivet (n=83)	Top Strap	18	0.9
		Bottom Strap	60	3.1
		Both Straps	5	0.3
	Strap Torn Near Middle (n=29)	Top Strap	17	0.9
		Bottom Strap	9	0.5
		Both Straps	3	0.2
	Strap Torn Near Velcro Hooks (n=242)	Top Strap	83	4.3
		Bottom Strap	100	5.2
		Both Straps	59	3.0
	Broken Buckle (n=178)	Top Buckle	19	1.0
		Bottom Buckle	146	7.5
		Both Buckles	13	0.7
Heel Strap (n=1137)		Center	338	17.4
		Velcro	435	22.4
		Rivet/Screw (Buckle End)	4	0.2
		Rivet/Screw (Velcro End)	308	15.9
		Bent Buckle	51	2.6
		Missing Buckle	1	0.1

<sup>a</sup>Note that when both ankle straps are broken this is actually 2 breakage events but they are listed as a single breakage in this table

d. Table 2 shows the PAB breakage data including the multiple breakages. There were 312 braces with multiple breakages. The most common multiple breakages were: 1) a torn Velcro on both ankle straps (n=35), 2) a torn heel strap rivet/screw on the Velcro side combined with a torn heel strap Velcro (n=29) and, 3) a broken back of the plastic heel combined with a torn heel strap Velcro (n=24). Of the multiple breakages, 89% involved the heel strap.

**Table 2. PAB Breakage Data By Brace (Showing Multiple Breakages)**

Breakage Number	Plastic Shell Location	Ankle Strap Location		Heel Strap Location		Cases (n)
		Ankle Strap/Velcro	Ankle Buckle	Heel Strap/Velcro <sup>a</sup>	Heel Buckle	
1	Back					173
2	Side					32
3		Ankle Strap Near Rivet – Top				10
4		Ankle Strap Near Rivet – Bottom				47
5		Ankle Strap Near Rivet – Both				4
6		Ankle Strap Middle – Top				14
7		Ankle Strap Middle – Bottom				4
8		Ankle Strap Middle – Both				2
9		Ankle Strap Velcro – Top				54
10		Ankle Strap Velcro – Bottom				65
11		Ankle Strap Velcro – Both				35

Table 2. (continued)

Breakage Number	Plastic Shell Location	Ankle Strap Location		Heel Strap Location		Cases (n)
		Ankle Strap/Velcro	Ankle Buckle	Heel Strap/Velcro <sup>a</sup>	Heel Buckle	
12			Ankle Buckle – Top			11
13			Ankle Buckle – Bottom			103
14			Ankle Buckle – Both			11
15				Heel Velcro		313
16				Heel Strap		271
17				Heel Strap Rivet/Screw 1		3
18				Heel Strap Rivet/Screw 2		229
19					Bent Heel Buckle	31
20	Back			Heel Velcro		24
21	Back			Heel Strap		5
22	Back			Heel Strap Rivet/Screw 2		4
23	Back	Ankle Strap Near Rivet – Top				3
24	Back	Ankle Strap Middle– Both				1
25	Back	Ankle Strap Velcro – Top				2
26	Back	Ankle Strap Velcro – Bottom				2
27	Back	Ankle Strap Velcro – Both				5
28	Back		Ankle Buckle – Bottom			3
29	Side			Heel Velcro		6
30	Side			Heel Strap		1
31	Side		Ankle Buckle – Bottom			2
32	Both Sides					1
33		Ankle Strap Near Rivet – Top/ Ankle Strap Middle – Top				1
34		Ankle Strap Near Rivet – Bottom Ankle Strap Middle – Bottom				1
35		Ankle Strap Near Rivet – Top/ Ankle Strap Velcro – Bottom				1
36		Ankle Strap Near Rivet – Bottom Ankle Strap Velcro – Bottom				1
37		Ankle Strap Middle – Top		Heel Strap Rivet/Screw 2		1
38		Ankle Strap Middle – Bottom		Heel Velcro		2
39		Ankle Strap Middle – Bottom		Heel Strap		2
40		Ankle Strap Near Rivet – Bottom		Heel Strap		4
41		Ankle Strap Near Rivet – Top		Heel Strap Rivet/Screw 2		3
42		Ankle Strap Near Rivet – Bottom		Heel Strap Rivet/Screw 2		2
43		Ankle Strap Near Rivet – Bottom			Bent Heel Buckle	1
44		Ankle Strap Velcro – Top		Heel Velcro		9
45		Ankle Strap Velcro – Bottom		Heel Velcro		15
46		Ankle Strap Velcro – Both		Heel Velcro		6
47		Ankle Strap Velcro – Top		Heel Strap		10
48		Ankle Strap Velcro – Bottom		Heel Strap		3
49		Ankle Strap Velcro – Both		Heel Strap		4
50		Ankle Strap Velcro – Top		Heel Strap Rivet/Screw 2		4
51		Ankle Strap Velcro – Bottom		Heel Strap Rivet/Screw 2		8
52		Ankle Strap Velcro – Both		Heel Strap Rivet/Screw2		7
53		Ankle Strap Velcro – Top			Bent Heel Buckle	1
54		Ankle Strap Velcro – Bottom			Bent Heel Buckle	1
55			Ankle Buckle – Top	Heel Velcro		1



Table 2. (continued)

Breakage Number	Plastic Shell Location	Ankle Strap Location		Heel Strap Location		Cases (n)
		Ankle Strap/Velcro	Ankle Buckle	Heel Strap/Velcro <sup>a</sup>	Heel Buckle	
56			Ankle Buckle – Bottom	Heel Velcro		10
57			Ankle Buckle – Top	Heel Strap		5
58			Ankle Buckle – Bottom	Heel Strap		12
59			Ankle Buckle – Both	Heel Strap		1
60			Ankle Buckle – Top	Heel Strap Rivet/Screw 2		2
61			Ankle Buckle – Bottom	Heel Strap Rivet/Screw 2		13
62				Heel Strap/ Heel Velcro		6
63				Heel Strap Rivet/Screw 1 /Heel Velcro		1
64				Heel Strap Rivet/Screw 2 /Heel Velcro		29
65			Ankle Buckle – Both		Bent Heel Buckle	1
66				Heel Velcro	Bent Heel Buckle	5
67				Heel Strap	Bent Heel Buckle	5
68				Heel Strap Rivet/Screw 2	Bent Heel Buckle	2
69				Heel Strap Rivet/Screw 2	Missing Buckle	1
70	Back	Ankle Strap Middle – Top	Ankle Buckle – Bottom			1
71	Back			Heel Strap Rivet/Screw 2 /Heel Velcro		1
72	Back	Ankle Strap Near Rivet – Both				1
73	Side	Ankle Strap Velcro – Bottom		Heel Strap Rivet/Screw 2 /Heel Velcro		1
74	Side		Ankle Buckle – Bottom	Heel Velcro		1
75	Side&Back	Ankle Strap Velcro – Top				1
76		Ankle Strap Near Rivet – Bottom		Heel Strap	Bent Heel Buckle	2
77		Ankle Strap Near Rivet – Bottom Ankle Strap Velcro – Top		Heel Velcro		1
78		Ankle Strap Near Rivet – Bottom Ankle Strap Velcro – Bottom		Heel Strap	Bent Heel Buckle	1
79		Ankle Strap Velcro – Top	Ankle Buckle – Bottom	Heel Strap		1
80		Ankle Strap Velcro – Bottom		Heel Strap/Heel Velcro		1
81		Ankle Strap Velcro – Bottom		Heel Strap	Bent Heel Buckle	1
82		Ankle Strap Velcro – Both		Heel Strap/Heel Velcro		2
83				Heel Strap Rivet/Screw 2 /Heel Strap/ Heel Velcro		1

<sup>a</sup> Heel Strap Rivet/Screw 1 is the buckle side; Heel Strap Rivet/Screw 2 is the Velcro side

## 7. DISCUSSION.

a. The data indicates that the majority of breakages occurred to the heel strap of the PAB. The Velcro attachment was the single area with the largest number of breakages. The center of the heel strap and the rivet on the Velcro end of the heel strap were subject to the second and third greatest number of breakages. In the multiple breakages, the heel strap was involved in almost 90% of the cases.

b. The reason for heel strap breakages is most likely the change in the military boot. The heel strap was originally designed for the older black combat boot as shown in Figure 7. This boot had a heel and the heel strap fit under the instep of the boot in front of the heel. This area secured the PAB to the boot, preventing backward slippage, and the heel strap was located where it would experience minimal contact with the ground. The first “new” boot was the desert boot with a heel (Figure 8) so the heel strap was still useful. However, about July 2005 a newer desert boot was issued in Army Basic Combat Training (Figure 9) and this new boot had a minimal heel area. Soldiers arriving at the USAAS from BCT had this new boot. When the PAB was placed on this new boot, the heel strap could slip over the curved part of the heel causing the plastic shell to move backward during walking. When this happened the heel strap was also directly under the heel and subject to abrasion from concrete in the harness shed, asphalt on the loading ramp, and dirt on the drop zone. The heel strap life span was considerably reduced.

c. DJ Ortho<sup>®</sup> in consultation with the USAAS developed a design that adds a stabilizing strap over the dorsum of the foot. Figure 10 shows a first prototype. A buckle loop is attached to the heel strap screws on both sides of the brace. A Velcro strap is inserted into the loop and secured across the top (dorsum) of the foot to better hold the brace in place. This should improve the stability of the PAB by preventing it from slipping off the boot. The heel strap should no longer slip back from the instep and will be afforded some protection as it should no be stepped on.

**Figure 7. Parachute Ankle Brace on the Older Black Combat Boot**



**Figure 8. Desert Boot with Heel**



**Figure 9. Desert Boot with Minimal Heel**



**Figure 10. Modified PAB for New Army Boot with Minimal Heel**

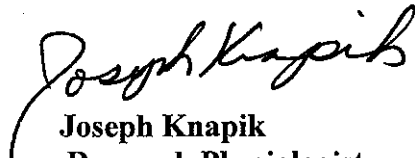


d. DJ Ortho<sup>®</sup> had made improvements on the plastic composition of the PAB for the third generation brace. About 1,000 of these new braces were shipped to the USAAS before the fourth batch was sent to the USACHPPM. Unfortunately, no distinction was made between the second and third generation braces in the fourth batch inventory and the braces were disposed of because of storage problems before this was considered. It was calculated that shell breakages accounted for 19% (199/1048) of the combined batch 1 through 3 breakages while shell breakages accounted for 11% (71/621) of all batch 4 breakages. The smaller proportion of shell breakages in the last batch suggests the third generation shell may be stronger.

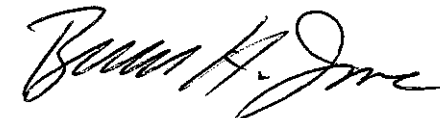
e. The ankle strap had the highest number of breakages at the attachment of the Velcro hooks to the Velcro pile. This accounted for 46% (242/532) of all ankle strap breakages and 12% (242/1947) of all breakages. Strengthening the attachment of the Velcro hooks to the strap may decrease the breakage incidence in this area.

**8. CONCLUSIONS.** The major breakage location on the PAB was the heel strap. On the heel strap, the Velcro, the center of the strap, and the rivet on the Velcro end were the specific areas subject to the greatest number of breakage events. A proposed modification has been developed by DJ Ortho<sup>®</sup> in consultation with the USAAS to more effectively hold the brace on the boot and reduce heel strap breakages. This modification adds a strap over the dorsum of the foot. The ankle strap at the Velcro attachment was also found to have a high level of breakage and strengthening the attachment of the

Velcro hooks to the strap may decrease the breakage incidence in this area. The modification of the plastic shell in the third generation PAB may have resulted in less shell breakage.



**Joseph Knapik**  
**Research Physiologist**



**Bruce H Jones**  
**Manager, Injury Prevention Program**

## **APPENDIX A**

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**APPENDIX B**  
**Documents Related to MTTF/DSOC Initiatives on the Parachute Ankle Brace**

From: Patton, James T Mr ASA-IE [<mailto:James.Patton@hqda.army.mil>]  
Sent: Monday, May 16, 2005 9:09 AM  
To: Angello Joseph J.CIV OSD-P&R; Aslinger, Jerry A. CTR OSD-P&R;  
Reinhard,Daniel E. CTR OSD-P&R  
Cc: Gunlicks, James B Mr. HQDA DCS G-3/5/7; Jones, Bruce H Dr USACHPPM;  
Curry, Daniel R CW5 HQDA DCS G-3/5/7; Timms, Charles MSG (OCAR-OPS);  
Back,Joe T COL HQDA DCS G-3/5/7; Romero, Anain J Ms OASA (I&E); Fatz,  
Raymond J Mr ASA-I&E  
Subject: Airborne Ankle Brace Update

Mr. Angello – attached is the Military Training Task Force update on the airborne ankle brace project. Please let us know if any additional information is needed.

Thanks, Jim  
James T. Patton  
Assistant for Safety  
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10 May, 2005

DEFENSE SAFETY OVERSIGHT COUNCIL MILITARY TRAINING TASK FORCE,  
WASHINGTON, DC 20301

SUBJECT: Update on Parachute Ankle Braces Airborne Training Injury Prevention

1. Implementation for use of the parachute ankle brace (PAB) at the Army Airborne School is progressing well. After a couple of early delays in the schedule due to a prolonged acquisition process, the project is back on track. Delivery the first shipment of braces occurred May 10<sup>th</sup> and distribution at the School is now scheduled for mid-May. Progress milestones for Phase I of the PAB project at the Airborne School, Ft. Benning, GA since January 2005 include:

Phase I: Evaluation of PAB at Airborne School

- An onsite PAB evaluation coordinator (Mr. Fred Manning) was funded and hired at Ft. Benning in February, 2005

- Army Natick Soldier Center (ANSC) received funds of \$130K to purchase 2,000 pairs of braces in mid-February.
- In late February, a request for bids to produce braces meeting ANSC specifications was written and opened for bids.
- Aircast Corporation was awarded the contract on the 25<sup>th</sup> March 2005.
- First delivery of braces was made to Ft Benning, GA 10 May 2005.
- The Army Research Institute of Environmental Medicine (ARIEM) received partial funds to initiate ankle brace evaluation in mid-February.
- ARIEM (COL Amoroso) has initiated the process for acquisition of Airborne School personnel data/student rosters, medical and safety data for ankle brace evaluation.
  - ARIEM and the Army Center for Health Promotion and Preventive Medicine (CHPPM) had conducted several teleconferences to coordinate activities with the Infantry Training Center QA Office (Ms Livingston) and the onsite PAB coordinator.
  - An Airborne School questionnaire has been developed to assess risk factors for jump-related injuries and injury outcomes at the end of each airborne class.
  - The questionnaire development involved ARIEM, CHPPM, USUHS and the Infantry School QA Office (Attachment file.).
- Infantry Training Center will deliver the questionnaire/survey to establish baseline injury risk factors, injuries and near misses and to follow rates post-PAB implementation.
- Baseline data will be collected until all airborne classes wear the PAB.
- Evaluation/comparison of PAB and Non-PAB use will begin with distribution of braces at the Airborne School in May/June 2005.
- Evaluation will be for 6 to 9 months post PAB distribution.
  - Briefings of results will be provided to the Airborne School, Infantry Training Center, and Defense Safety Oversight Council (DSOC) at the completion of the evaluation period and a written report will be produced for the DSOC.

2. Ground work for initiation of Phase II of PAB implementation in operational units at Ft. Bragg continues simultaneously with the above efforts at Ft. Benning. Milestones for Phase II include:

Phase II: Evaluation of PAB in Operational Units

- FORSCOM HQ and Ft Bragg Operational Airborne Unit briefings.
- PAB purchase, distribution and evaluation for operational units at Ft Bragg will follow a plan and timeline following brace acquisition similar to the Airborne School above.
- Evaluation of the PAB will continue for 6 to 9 months post PAB distribution to units at Ft Bragg.
- ANSC will produce an updated PAB requirements document 6–12 months post evaluation.



- Results from operational units at Ft. Bragg will be briefed to 18<sup>th</sup> Airborne Corps and 82<sup>nd</sup> Airborne Division unit Commanders following completion of Phase II evaluation there.
3. Following the conclusion of Phase II at Ft Bragg briefings will be given to the Military Training Task Force and Defense Safety Oversight Council (DSOC) and a final report with conclusions and recommendations regarding PAB implementation will be prepared and delivered to the DSOC.

Jim Gunlicks  
Chairman, DSOC MTTF



OFFICE OF THE SECRETARY OF DEFENSE  
WASHINGTON, DC 20301

April 15, 2005


MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY  
(ENVIRONMENT, SAFETY AND OCCUPATIONAL HEALTH)  
AVIATION SAFETY IMPROVEMENTS TASK FORCE CHAIR  
MILITARY TRAINING TASK FORCE CHAIR  
WORKERS' COMPENSATION TASK FORCE CHAIR

SUBJECT: Defense Safety Oversight Council (DSOC) Follow-up Actions

As discussed in our April 6, 2005 Integration Group meeting, we need to provide a status to the DSOC Chair on the four high priority projects directed in PBD 705. These include the efforts on Return to Work, Military Flight Operations Quality Assurance (MFOQA), Voluntary Protection Program (VPP), and Paratrooper Ankle Braces.

I ask that you submit a brief memorandum on your initiatives to me that includes a description of the process to implement the initiative, the steps taken to date, and future actions. Please also include a financial summary with the status of funds expended to date.

If you have questions or desire additional information, please contact Mr. Jerry Aslinger at 703-604-0838, or by email at [Jerry.Aslinger.ctr@osd.mil](mailto:Jerry.Aslinger.ctr@osd.mil).

  
Joseph J. Angello, Jr.  
Executive Secretary  
Defense Safety Oversight Council

cc: DSOC Integration Group Members  
DSOC Task Force Chairs





## MTTF Project 13

### AIRBORNE TRAINING INJURY PREVENTION

☐ Action Complete

**Objective Description:** Ankle injuries account for 30 to 60% of all parachuting injuries. Army Airborne trainees who trained during periods when the Parachute Ankle Braces (PABs) were not in use were twice as likely to sustain an ankle injury requiring hospitalization compared to paratroopers who trained while the PABs were in use. Reintroduce PABs in order to reduce frequency and severity of lower extremity injuries during basic airborne school training.

**Performance Measure:** Reduction in lost training time, clinic visits, hospitalizations, and non-graduation rates due to ankle and lower extremity injuries caused primarily from parachute landing falls during Basic Airborne Training. No increase in other injuries. Injury reduction begins immediately with use of braces. USARIEM has already established metrics for evaluation/assessment.

**Return on Investment:** Estimated savings of \$3.3 million in medical care costs annually due to 50% reduction in serious ankle injuries among trainees and estimated 75-80% reduction in mild ankle injuries; greater efficiency in training cycle; improved readiness.

**Lead:** MTTF/USARIEM

Action	Target Date	Actual Date	Lead
Develop Plan	Jul 2004	Nov 2004	MTTF
Manufacture, purchase, and delivery of PAB	Oct 2004		MTTF
Obtain Funding	Oct 2004	Dec 2004*	DSOC
Begin evaluation of ankle brace at Airborne School	Nov 2004	Pending Acquisition	MTTF
Evaluate brace in operational units	Pending Funds	Pending Funds	ARIEM
Upon success, field to all airborne units	Pending Funds		MTTF

**Objective Assessment:** GREEN

**Current Status:** GREEN

Pending coordination and purchase of braces.

Baseline data collection has been initiated. The Army Airborne School is prepared to launch the re-implementation phase as soon acquisition of braces has been completed.

Implementation in operational units awaits initiation at Airborne School and further coordination.

#### Key Actions

- Coordinate and plan implementation of brace at AB school
- Purchase braces and begin intervention at Airborne School
- Coordinate evaluation, purchase & implement PAB in operational units
- Conduct evaluation and analyses (USARIEM TAIHOD)
- If successful, procure 20,000 pair of braces (6-8 weeks to manufacture) and field to all Airborne units

#### Inhibitors

- Airborne community cultural resistance to change
- Cost of the Parachute Ankle braces (\$60/pair)

#### Resource Requirements

- \$300K evaluation and analysis of AB School & operational units (2005)
- \$1.2M to outfit school & operational units with braces (2005)
- \$600K/year out-years cost for brace replacements

\*Potential PBD 705 Funding

Updated: February 2005

**APPENDIX C**  
**Acknowledgements**

We would like to thank LTC Timothy Mitchener for providing equipment for some of the photographs.